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Research on Collaborative Product Design Issue Tracking Management Model *

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Abstract

Product development teams are usually confronted with numerous issues in collaborative design process. The issue tracking management can provide the efficiency and effectiveness of the development process. Firstly, the process of issue tracking management and organization are analyzed. We study the relationship between privileges of roles' and issue states. Secondly, we propose a product issues structure model (PISM) which associates issues with product at the component level. With the PISM, the developers can understand of the issue state so as to promote the issue resolution. Finally, we applied an approach which analyzes the density of product issues in the evolvement of product issue structure to assist the product manager in identifying improvement opportunities.

Keywords: Issue tracking; Product structure; Issue information modeling; Collaborative design

1. Introduction

The collaborative product design processes are regarded as overlapped iterative design activities such as raising design issues, and find solutions to improve design [1]. Solutions to product design issues are invaluable knowledge resources of any firms'. Reusing them means high quality, low cost, short lead-time to market [2]. However, many of them don't have any product design issues management system. They have been facing difficulties as follows:

(1) Some of issues aren't reported to the right persons in time. As the later an issue is reported, the more it costs to fix [3]. Product managers cannot duly administrate the responsible projects owing to the

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lack of the necessary information about product issues. When many people implement one design project at the same time, it's hard to distinguish their responsibilities for existing issues clearly [4].

(2) Various descriptive formats on product issues are adopted by members of design team. Without a uniform description model of product issues, the low communication efficiency results in delay of product release.

(3) Most solutions to product issues, which proved useful, are distributed in various databases. So it's too difficult to reuse them effectively.

In this paper, we propose a product issues structure model based on the product design structural tree which not only helps every team member to focus on product issues according to his/her discipline, but also gives product managers a new way to track overall issues for controlling underlying risks.

2. Issue Tracking Management Process and Organizations

All the issue lifecycle states are shown in Figure 1. Once some problems of product are detected, the issues would be submitted immediately. An issue reporter can be any members of the product development team as well as automatic detection systems integrated with issue tracking system. The product development manager analyzes every issue by its report. The issue which is mistaken would be closed directly by the manager. Most resolutions to issues would be decomposed into sub-tasks by the manager. Functionaries must finish sub-tasks on time. Finally, estimators decide whether the issue resolution is feasible. The issue would be closed if its resolution is acceptable, or it should be transferred to the resolution state or the analysis state.

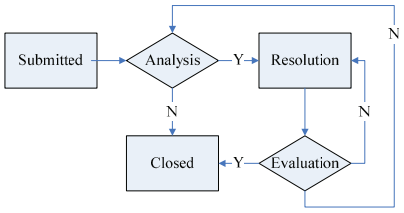

Fig.1 Lifecycle States of Product Issue

In the product issue lifecycle there are four roles which are reporter, manager, functionary and estimator. The issue operations consist of Create (C), Edit (E), Delete (D), Search (S) and Browse (B). With an issue states changes, the privileges of roles' are changed dynamically. The relationship between privileges of roles' and issue states are shown in Table 1.

Table 1relationship between priileges of roles' and issue states

		Roles			
		Reporter	Manager	Functionary	Estimator
Issue States	Submitted	C			
	Analysis	S/B	E/D/S/B		
	Resolution	S/B	S/B	E/S/B	
	Evaluation	S/B	S/B	S/B	S/B
	Closed	S/B	E/S/B	S/B	S/B

3. Product Issues structure Model

A product structure model is the core of product data model [5]. A product data model can be expressed as a product structural tree which is composed of data objects and relation objects. It proposed that a product data model consists of many views with the design view as the core [6]. Based on analysis of connotation of existing product structural model, the concept of the product lifecycle structural model and the modeling method were proposed [7]. The product design structural sub-tree is the core of product lifecycle structural sub-trees. On the basis of current research above, we present the PISM which is shown in Fig. 2.

The product '0' is assembled by the sub-assembly '1' and the sub-assembly '2'. The sub-assembly '1' is assembled by the part '1_1' and the part '1_2'. The sub-assembly '2' is assembled by the part '2_1' and the sub-assembly '2_2' which is assembled by the part '2_2_1' and the part '2_2_2'.

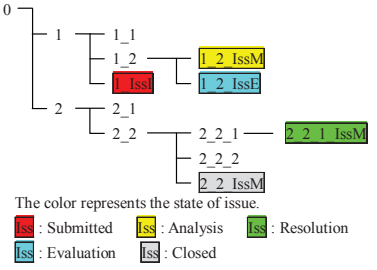

Fig. 2 Product Issues Structure Model

Generally, the product development team consists of multi-discipline members, whose knowledge domains and responsibilities are different. Therefore, they are concerned with the different aspects of product design. For instance, the industrial designers focus on the product form, style, painting etc, but the manufacturing engineers devote themselves to manufacturing processes. In Fig. 2 five issues are shown. 1_IssI, which is under the charge of the industrial designers, indicates that there is something wrong with the sub-assembly '1'. 1_2_IssM, 2_2_1_IssM and 2_2_IssM show that issues of the part '1_2', the part '2_2_1' and the sub-assembly '2_2' should be fixed by the manufacturing engineers. Moreover, 1_2_IssE affixed to the part '1_2' should be fixed by the electronic engineers.

The issues are classified as the part issues and the assembly issues by their position in PISM.

(1) The part issues indicate there is something wrong with the single part, such as the part surface defects.

(2) The assembly issues indicate there is something problems with the assembly, for example the assembly interference.

It's very important for the product developers to see the issues state in time. In instance, the state of '1_IssI' is submitted in Fig. 2. Then the product manager must analyze it and determine how to decompose tasks for resolving the issue as soon as possible.

4. Product Issue Information Modeling

The product issue is an object which the design team would track and manage. Thus, the information of product issue must be sufficient for issue tracking and management. The product issue information modeling deals with where the product issue is stored (in which database), where the product issue is

happened (in which node of PISM) and what the information of product issue is (e.g. issue states, priority, severity, etc.), that is (1)

ISSUE = {{IssueID, ProjectID, ProjectName}, {NodeLocation, NodeName}, {Reporter, TimeReported, Details, Severity, Type, Priority, States, Solution}} (1)

The first part is to record the basic storage location information of this issue including the issue identification, the project (or product) code and name in the database.

- IssueID – the unique identification of issues
- ProjectID – the unique identification of projects
- ProjectName – the names of projects

The second part is to describe the issue node location in PISM.

- NodeAddress – the unique address of issue node in PISM
- NodeName – the name of component which opens issue

The third part is to represent the issue detail which consists of nine elements which are as follow

- Reporter – the person who finds and reports the issue
- Time Reported – the time when an issue is reported
- Details – the description of issue
- Technology – the method by which the issue reporter detects
- Severity – the measurement of a negative impact which an issue has on
- Type – a group of issues of the same general character, e.g. surface quality, assembly interference and so on.
- Priority – precedence established by order of issue importance or urgency， possible values are: low, medium, and high
- States – the states of issue in operation, possible values are: submitted, analysis, resolution, evaluation and closed
- Solution – Solution is made from the TASK which the product manager determines to decompose by analyzing the issue report. TASK is a set of tasks which the product developers answer for. The solution is defined as (2).

$$\text{Solution(IssueID)} = \{\text{EstimatedTime, ActualTime, TASK(IssueID)}\} \quad (2)$$

- EstimatedTime – the estimated time to fix the issue
- ActualTime – the actual time to close the issue
- TASK(IssueID) – a set of tasks which the product developers answer for.

5. Issue Tracking Management Analysis

PISM which is a dynamic structure would update in real time. In Fig. 3, every issue node (e.g. 1_IssI in Fig. 2) in PISM is replaced by a disc, whose color represents the state of issue. The patterns a), b) and c) present the dynamic PISM at stage 1, stage 2 and stage 3. PISM in Fig. 2 is the same as a) in Fig. 3. At stage 2, a new issue on the part '1_2' is submitted. The other existing issues are in operation, except 1_IssI whose state is submitted. The manager has to pay more attention to it. The product design cannot be finished until every issue of the product issue structural tree is closed (e.g. at stage 3).

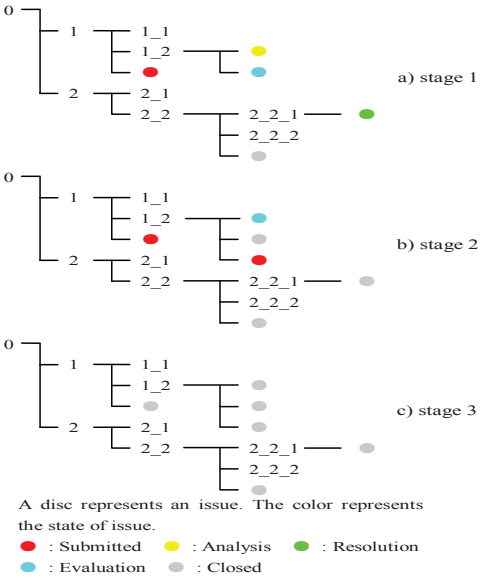

Fig. 3 Evolvement of Product Issue Structure

The product manager could analyze the evolvement of product issue structure to identify improvement opportunities. In instance, to analyze the density of product issues, the manager can find out which component should be spend more resources to developed (e.g. the part '1_2'), which issue is delayed (e.g. 1_IssI) et al.

In Fig. 4 we can get a quick and effective overview over the evolvement of product issues. Every line represents an issue lifecycle. It is pointed out that how long it takes for an issue from a state to the other state. The slope of line segment implies the speed of issue state transition. For example, the manager should pay attention to 2_1_1_IssM in Fig. 4. Because compared with the other issues, 2_1_1_IssM costs much time in the phase of analysis. We can attain insights into potential points for improvement of the product development.

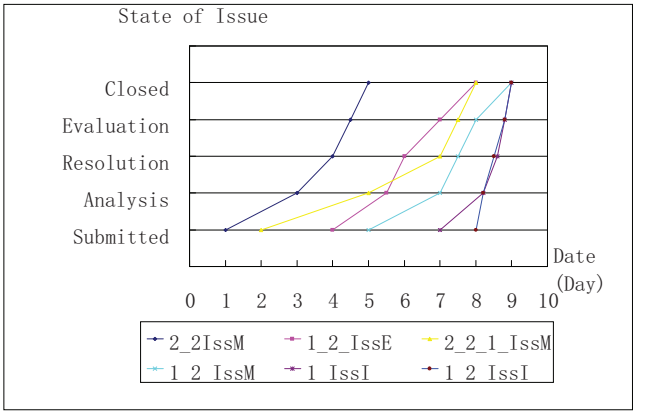

Fig. 4 Evolvement of Product Issue

6. Conclusions

The collaborative product developers are faced with a great deal of issues frequently. The product development cannot be finished until all issues are resolved. It is obvious that the issue tracking management could provide the efficiency and effectiveness of the development process. In this paper, by analyzing the process of issue tracking management, we study the relationship between privileges of roles' and issue states. To track product issues availably, we propose PISM based on the product design structural tree. PISM associates issues with product at the component level. With the PISM, developers can see the state of issues' clearly so as to they can deal with every issue in time. We also study the product issue modeling, which settles where the product issue is stored (in which database), where the product issue is happened (in which node of PISM) and what the information of product issue is. In a case study, we applied an approach which analyzes the density of product issues in the evolvement of product issue structure to assist the product manager in identifying improvement opportunities.

The issue tracking management helps product development teams manage issue reporting, assignment, resolution, and evaluation throughout the lifecycle of the product development. The issue can provide excellent sources for the product design improvement opportunities. The issue-based knowledge management research is being tried.

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Wei Du, who is the main author of this paper, was born in 1981. He studies in Key Laboratory of Contemporary Design and integrated Manufacturing Technology, Northwestern Polytechnical University for his doctor degree, whose major is Aeronautics & Astronautics Manufacturing Engineering.

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